Study on Usefulness of Blood Lactate Measurement and Transrectal Ultrasonography for Diagnosis of Uterine Torsion Severity in Dairy Cows

Summary of Doctoral Thesis

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In cows, uterine torsion occurs in the uterine body at the base of both uterine horns or at the cervix, unlike in cats where it occurs at a uterine horn. Clockwise torsion, when viewed from the rear of the cow, is also referred to as right torsion, and counterclockwise torsion as left torsion. Known causes of bovine uterine torsion include 1) increased uterine mobility due to extension of the broad ligament of the uterus, which suspends the uterine horns in the abdominal cavity; 2) anatomical factors, such as the uterus compressed by the rumen, a large organ occupying nearly the entire left abdominal cavity; 3) swaying of the uterus when the cow stands up; 4) fall or sliding in a cattle barn; and 5) fetal movement during late pregnancy. Bovine uterine torsion occurs in the second half of pregnancy, during late pregnancy, or during delivery, and is more likely to occur in dairy cows than in beef cows, accounting for about 10% of the causes of bovine dystocia. Prolonged uterine torsion can lead to fetal death or maternal debilitation.

Treatment options for bovine uterine torsion include inserting a hand through the vagina into the uterus to grasp and rotate the fetus in the opposite direction to torsion (fetal version); laying down the cow and then rotating the cow in the same direction as torsion (maternal version); maternal hindlimb lifting; and open surgery. From these options, the optimal reduction/treatment strategy must be selected, taking into account the time from occurrence,

severity of torsion, and maternal and fetal conditions. However, with no defined markers or criteria for determining the optimal treatment strategy for uterine torsion, veterinarians have made treatment decisions based on their own personal experience. This has prevented the provision of appropriate treatment for mild, moderate, and sever uterine torsion, resulting in delayed reduction of torsion as well as fetal death and marked maternal debilitation in many cases. The presence and severity of bovine uterine torsion can usually be determined by vaginal or rectal examination, with no other acceptable scientific diagnostic procedures.

Congestion and decreased circulation/hypoxia in organs and tissues are known to cause increased blood lactic acid levels. Studies have suggested the usefulness of blood lactic acid levels for predicting the prognosis of equine colic and bovine abomasum displacement. It has also been reported that destruction of cells in organs and tissues lead to increased blood activities of aspartate aminotransferase (AST) and creatine phosphokinase (CK). Depending on its severity, bovine uterine torsion may also lead to congestive necrosis of the uterine wall. The objectives of this study were to determine whether blood lactic acid levels and blood AST/CK activity levels can be markers for the severity of symptoms in dairy cows with pregnancy-related uterine torsion and can guide the selection of a proper strategy for reducing/treating uterine torsion. We also investigated whether the severity of congestive

necrosis of the uterine wall due to uterine torsion as determined by ultrasonography can be a marker for the severity of uterine torsion, treatment selection, and prognosis.

1. Effect of obstetrical procedures after reduction of uterine torsion in dairy cows on maternal/fetal survival and subsequent maternal reproductive performance (Chapter 2)

A total of 112 Holstein cows in which uterine torsion was successfully reduced by non-surgical techniques were divided into 3 groups according to the post-reduction obstetrical procedure used to pull/deliver the fetus from the uterus: group A, no treatment or mild pulling (n = 48); group B, moderate or intense pulling (n = 48); and group C, cesarean section due to inability to pull the fetus. These 3 groups were compared for maternal and fetal survival rates and subsequent maternal reproductive performance. The maternal survival rates in groups A, B, and C were 97.9%, 89.6%, and 75.0%, respectively, with the rate in group C significantly lower than that in group A ($p < 0.05$). The post-delivery survival rates of calves in groups A, B, and C were 83.3%, 52.1%, and 18.8%, respectively, with the rates in groups B and C significantly lower than that in group A ($p < 0.05$). The maternal conception rates after artificial insemination during the first year after reduction of uterine torsion in groups A,

B, and C were 89.4%, 67.4%, and 66.7%, respectively, with the rates in groups B and C significantly lower than that in group A ($p < 0.05$).

These results demonstrate that excessive pulling of the fetus significantly affects maternal and fetal survival rates. The unfavorable maternal and fetal survival outcomes after cesarean delivery may be due to the tendency for cesarean operations to be performed long after the occurrence of uterine torsion caused by failed attempts of non-surgical reduction. These results suggest the need for diagnostic criteria or markers in favor of earlier cesarean delivery.

2. The usefulness of blood lactic acid levels for diagnosing uterine necrosis due to uterine torsion and prognosis prediction in dairy cows

   (Chapter 3)

   We investigated whether blood lactic acid levels and blood AST/CK activity levels can be used as markers for the severity of uterine torsion and the prognosis of mother cows after reduction/treatment of uterine torsion.

Blood samples were collected from 54 Holstein cows with untreated uterine torsion and measured for lactic acid, AST, and CK levels. Cows with congestive necrosis of the uterine

wall due to uterine torsion (severe group) showed a mean blood lactic acid level of 15.0 mmol/L, compared with 3.0 mmol/L in cows without necrosis, with a significant difference ($p < 0.01$). Meanwhile, no significant difference was observed in blood AST or CK activity levels. Moreover, the mean blood lactic acid levels in mother cows that died and survived after treatment of uterine torsion were 10.2 and 3.1 mmol/L, respectively, with a significant difference ($p < 0.01$). In contrast, no significant difference was observed in blood AST or CK activity levels between the two groups.

By statistical analysis, the lactic acid cut-off for suspecting uterine necrosis due to uterine torsion was determined as ≥5.0 mmol/L, and that for indicating poor prognosis even after reduction of uterine torsion as ≥6.5 mmol/L.

These results demonstrate that blood lactic acid levels can be used as a marker for determining the severity of uterine torsion and the prognosis of mother cows. In a clinical setting, cows with uterine torsion should be measured for blood lactic acid levels using a commercially available portable measurement device and lactic acid levels higher than 5.0 mmol/L should prompt early cesarean delivery, rather than attempting non-surgical reduction.

3. Diagnosing the severity of uterine torsion by ultrasonography combined with blood lactic acid measurement (Chapter 4)

A total of 33 Holstein cows with uterine torsion were subjected to measurement of blood lactic acid levels and rectal ultrasonography to determine the thickness of and any damage in the uterine wall. Cows with blood lactic acid levels of ≥5.0 mmol/L were found to have an increased uterine wall thickness of 15–25 mm and were more likely to have damage in the uterine wall such as congestive necrosis. The degree of uterine torsion in these cows was considered to be severe. These results demonstrate that the severity of uterine torsion in cows can be accurately diagnosed by blood lactic acid levels and ultrasonography findings of the uterine wall. Cows with reduced uterine blood flow due to uterine torsion tended to have reduced maternal as well as fetal survival rates. Thus, for cows with severe uterine torsion, early cesarean delivery should be considered, rather than wasting time attempting non-surgical reduction, in order to improve fetal survival outcomes, avoid maternal debilitation, and preserve subsequent maternal reproductive performance. In cows with uterine torsion, the combined use of blood lactic acid measurement and ultrasonography of the uterine wall is very effective in determining proper treatment strategies for uterine torsion and for accurate prognosis prediction.